User-side Channel Charting for Access Point Selection

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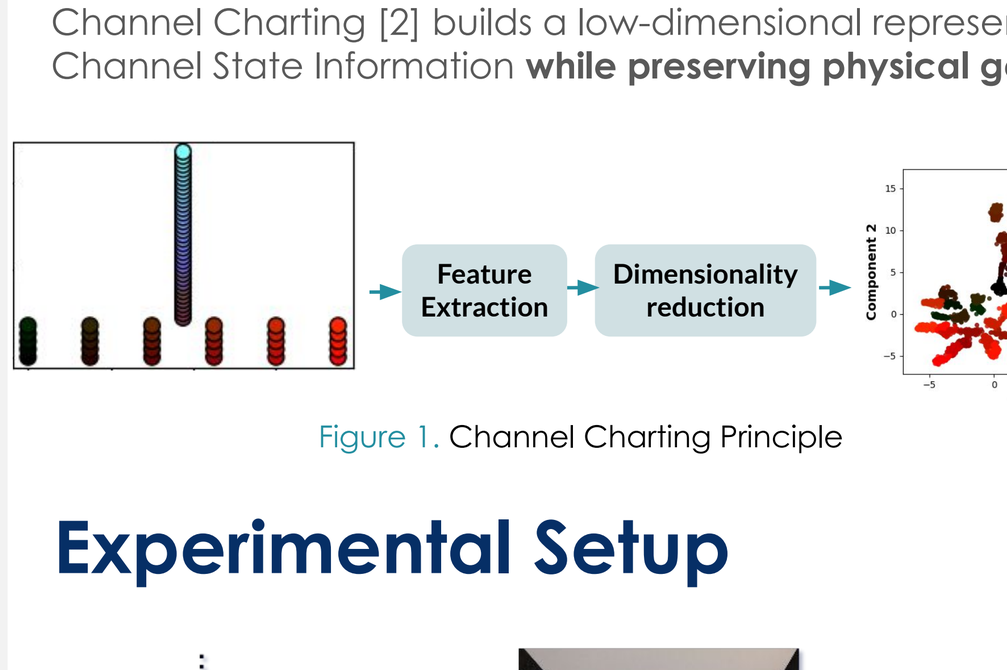
Context

End users have access to **heterogeneous networks (e.g., Hybrid Li-Fi + WiFi[1], or cellular + Wi-Fi)**



- End-user devices can access multiple wireless networks.
- These networks are often operated independently.
- As the user moves, devices must take network decisions.
- Decisions often based on static logic.
- User's past experience not exploited.
- **Goal**: A user-side mobility-aware connectivity management based on past experience.
- **Challenge**: User-side tracking system.

Proposition

Opportunistic Channel Charting based connectivity management

Channel Charting [2] builds a low-dimensional representation of Channel State Information **while preserving physical geometry.**

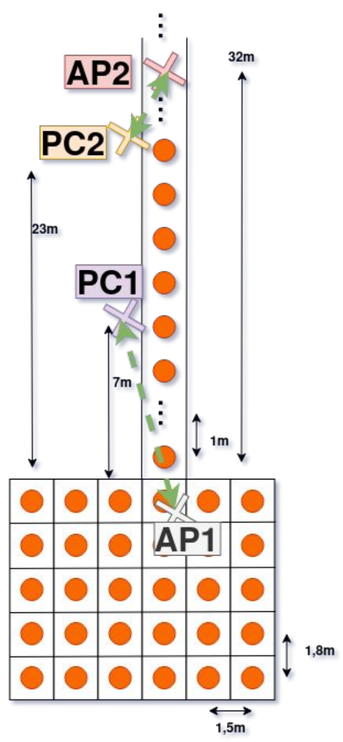
Figure 1. Channel Charting Principle

- Opportunistic Channel Charting (OCC) is a user version of Channel Charting that:
  - Opportunistically collect CSI from ambient APs.
  - Allows user-device to track itself
- **We propose a dynamic hysteresis threshold[3] based on OCC.**

Learning Phase
- Build Channel Chart
- Learn Threshold association.

AP Selection
- Periodic CSI collection
- Hysteresis threshold setting

Experimental Setup



Results

MAC	Distance Metric	TW	CT
AP1	Hamming	0.91	0.92
AP1	Cityblock	0.88	0.90
AP2	Cityblock	0.89	0.93
AP2	Cosine	0.73	0.81

Table 1. Channel Charting performance

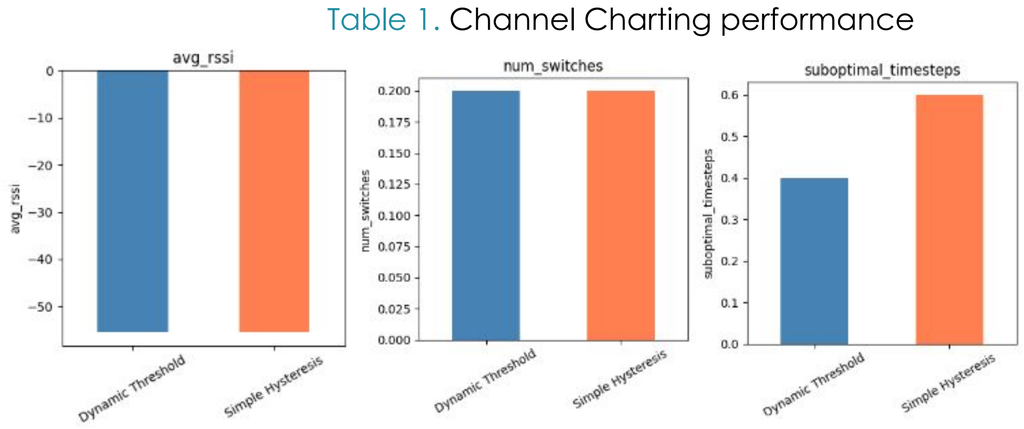


Figure 2. AP selection scheme performance

References

1. X. Wu, D. C. O'Brien, X. Deng, and J.-P. M. G. Linnartz, "Smart Handover for Hybrid LiFi and WiFi Networks," vol. 19, no. 12, pp. 8211–8219.
2. C. Studer, S. Medjkouh, E. Gonultaş, T. Goldstein, and O. Tirkkonen, "Channel Charting: Locating Users Within the Radio Environment Using Channel State Information," vol. 6, pp. 47682–47698.
3. Lee, J. H., Lu, Y., & Doppler, K. (2025). On-device LLM for context-aware Wi-Fi roaming. *arXiv preprint arXiv:2505.04174*.

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